

THE INSECTS AND PLANTS OF A SALT MARSH ON THE COASTAL PLAIN OF NEW JERSEY

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INTRODUCTION

This paper is the third of a series dealing with plant and insect surveys of various sections of New Jersey. The first dealt with conditions in a moist woods on the Piedmont Plain of New Jersey and the results were published in the *JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY* (vol. xxx, No. 4, Dec., 1922, pp. 169-190). The second covering an area in the "pines" of New Jersey was submitted to "Ecology". The present paper is concerned with the plants and insects of a salt marsh on the coastal plain of New Jersey. In all three papers an effort was made to show the types of insect food habits present and their relationship to the flora.

ACKNOWLEDGMENTS

The insects collected were identified by the following entomologists, to whom we are greatly indebted: Mr. C. W. Johnson, Diptera; Mr. C. A. Frost, nearly all of the Coleoptera; Mr. Howard Notman, Staphylinidæ; Mr. Henry L. Vierick, Hymenoptera; Mr. William T. Davis, Orthoptera and Odonata; Mr. Harry G. Barber, Hemiptera; Mr. C. E. Olsen, Cicadellidæ and Fulgoridæ; Mr. M. R. Smith, Formicidæ.

THE NEW JERSEY SALT MARSH

About three-fifths of the entire area of New Jersey belong to the coastal plain and the salt marsh areas are found for the most part lying between the bars fringing the coast and the mainland. Marsh land is found also along Delaware Bay and extending for some distance along the rivers stretching inland through the marshes. Mr. C. C. Vermeule (*Geol. Survey, N. J.*, vol. I, 1888, p. 178) has calculated that some 660 square miles of New Jersey including some small water areas consist of tide marsh,

this estimate including the tide marshes of the Hackensack valley. Excluding the Hackensack valley marshes, the tide marsh area of the coastal plain embraces about twelve per cent of its area.

Prof. John B. Smith (N. J. Agr. Exp. Sta. Bul. 207, pp. 6-8), writing about the New Jersey salt marsh and its improvement, states that there are three general types of marsh land. The first is covered at every mean high tide and may or may not support sedge or joint grass. This type is more plentiful south of Great Bay and is the smallest in area. The second type is rarely covered at ordinary tides but is so little above mean high water that slight rises due to wind, storm or moon changes result in a watery covering. This type may be covered by sedge but more usually has a thin growth of joint grass and is generally very flat and level. This type is also more plentiful south of Barnegat Bay. The third type is above mean high tide but likely to be covered by spring and fall tides and by winter or storm tides. Such marsh is more or less completely covered by vegetation and cut by creeks and waterways.

Dr. Witmer Stone (Plants of So. N. J., N. J. St. Mus. Rept., 1910, p. 97) lists some 40 species of plants as making up the true salt marsh vegetation and states that of these, *Spartina patens*, *Distichlis spicata*, *Juncus gerardi*, *Salicornia europæa*, *S. bigelovii* and *S. ambigua* make up the bulk of the vegetation on the open marsh. Prof. Smith (loc. cit.) states that the upper layer of the average salt meadow extending from 12 to 18 inches in a huge sponge composed of a mass of roots and vegetable material capable of holding water and drying out slowly by surface evaporation. A salt marsh sod 10 by 10 by 27 inches weighing 121 pounds was taken by Prof. Smith from the Raritan marsh in 1907 and turned over to Dr. Jacob Lipman, who furnished the following statement concerning it:

Original weight	121	pounds
Dry weight	23.39	pounds
Moisture	80.67	per cent
Dry matter	19.33	per cent
	Upper portion	Lower portion
	per cent	per cent
Nitrogen	0.65	0.63
Organic matter	34.23	21.30
Ash	65.75	78.70

Dr. Lipman also stated that "the spongy, fibrous character of the upper portion of the sod is gradually modified in its lower portion. The distinct root structure tends to disappear and with the darker color the entire mass becomes more compact and resembles muck rather than peat. The proportionate amount of carbon and ash are both increased, while the proportion of organic matter is diminished."

THE SURVEYED AREA

The surveyed area consisted of about five acres of marsh belonging to the third type as outlined by Smith and having a shape somewhat similar to an isosceles triangle. The two long legs of the triangle were bounded by rather wide natural ditches and the base by a narrow, artificial ditch. The short and one long side of the triangle were protected from the waterfront of Raritan Bay by large bluffs but the other long side faced the balance of the Cheesequake meadow which extends inland along the Cheesequake creek. The exact location which lies in about latitude $40^{\circ} 27' N.$ and longitude $74^{\circ} 15' W.$ will be found on the accompanying map. Collecting was done at regular weekly or ten-day intervals throughout the seasons and an effort was made to obtain a fair sample of the species present regardless of the groups to which they belonged. The prevailing winds were toward the bluff and waterfront of Raritan Bay and for this reason it is supposed that not many species from the bluff found their way to the marsh. Most of the species were collected by sweeping the vegetation. Sifting of the soil was out of the question on account of its water-logged condition.

Dr. W. Rudolfs, bio-chemist at the New Jersey Agricultural Experiment Station, very kindly examined a sod taken from the section where the survey was made and supplied the following table, which shows the hydrogen-ion concentration at different depths as indicated by the values under pH. The hydrogen-ion concentration indicates the active acidity of the soil *in toto* and the lower the figure, the greater the acidity, the neutral point being 7.0.

	pH	Color of supernatant liquid
Soil three inches deep	6.6	transparent
Soil six inches deep	6.2	yellow xxx
Soil nine inches deep	6.4	yellow xx
Soil twelve inches deep	6.9	yellow x
Water in hole from which sod was taken.....	6.9	transparent

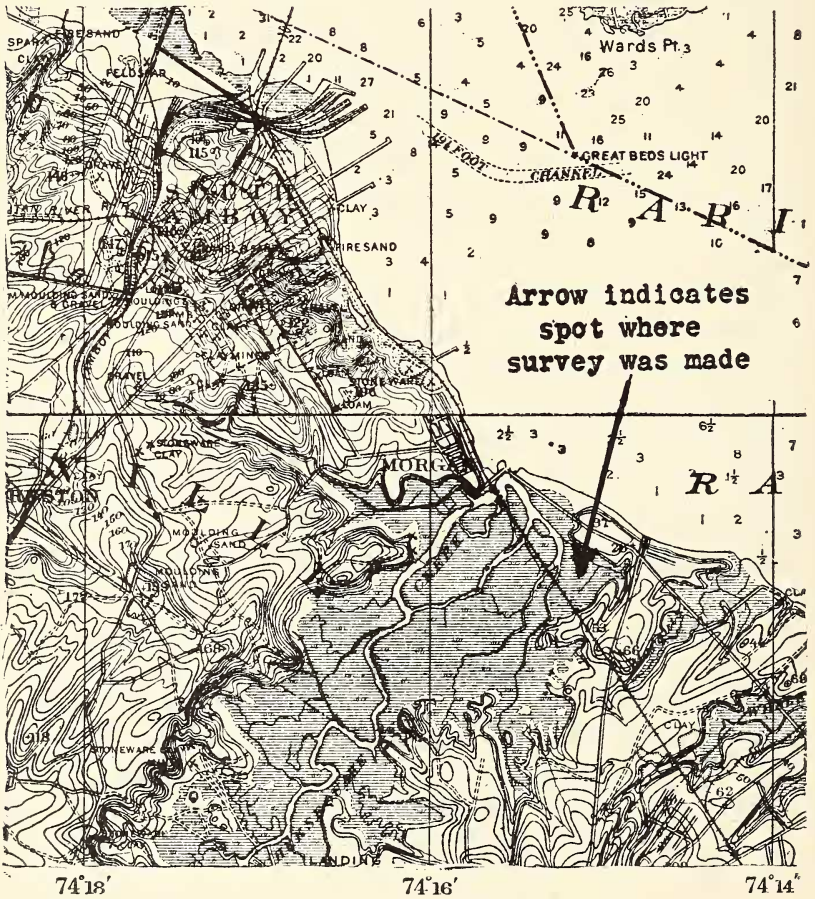


FIG. 1—Map of Cheesequake Marsh showing where the survey was made.

Dr. Rudolfs stated that the changes in reaction in the different layers of soil and the change in color seemed to indicate that the area was occasionally flooded by salt water, and this was true as observed during the survey. Some of the salt stays in the top layer and with progressive depths a part is leached out or possibly taken up by the plants, whereas at the place where the root systems of the plants stop, hydrogen-ion concentration decreases and goes up nearly to the neutral point. Dr. Rudolfs suggests that this might be caused by poor drainage at this depth, especially since the water in the hole registered the same degree of hydrogen-ion concentration. The yellowness of the water indicates that the roots are decaying leaving a colloidal substance in the soil.

THE VEGETATION OF THE SURVEYED AREA

The vegetation of salt marshes in general is characterized by the monotony of its general aspect, for it lacks contrasts or even striking variations in the color or size of its component parts. The vegetation of the surveyed area was no exception to the rule; in fact, the general trend was emphasized in the paucity of the species present and the marked tendency for them to grow in pure stand. Three typical salt marsh plants, *Spartina patens*, *Distichlis spicata* and *Juncus gerardi*, covered a large proportion of the marsh. The first two only showed a slight tendency to intermingle and at least sixty per cent of the area was covered by these two plants. The other forty per cent was composed of the various other species mentioned later with *Spartina glabra* and *Juncus gerardi* as the most prominent. As a whole the marsh was well drained and there was an absence of pools or "rotten spots" as they are frequently called. However, a few plants characteristic of such conditions were found mingled with the grasses mentioned above. *Atriplex patula*, *Salicornia europæa* and *S. mucronata* were three well distributed though inconspicuous species. They were most numerous where the grass mat was least dense. Occasional patches of sea lavender, *Limonium carolinianum* were conspicuous at blooming time with their large mist-like sprays of lavender colored flowers. Their broad leaves were also different from the usual leaf-type of the marsh.

Along the creeks and ditches there was a border of tall, salt grass, *Spartina glabra*. Where the banks were sloping and low, the border was wide, but where the banks were steep, it was narrow, and the dividing line between it and the low grasses of the marsh proper was sharp. Along the banks of the larger streams there was mingled with the tall salt grass the shrubby marsh elder *Iva oraria*, which sometimes extended along the smaller ditches where the tall, salt grass did not invade.

A vista of the entire area after the first of July showed a flat marsh dissected at irregular intervals by hedges of marsh elder or the tall, salt grass or both. In the flat marsh, especially where *Spartina patens* predominated, the low grassed were billowed and sometimes almost prostrate from the effects of the prevailing winds, together with the work of occasional high tides.

THE INSECTS OF THE SURVEYED AREA

The following tables summarize the insect findings by orders and families:

INSECTS COLLECTED ON IVA ORARIA

Order and family	Number of species	Order and family	Number of species
Neuroptera		Coleoptera	
Chrysopidæ	1	Coccinellidæ	5
Homoptera		Lampyridæ	1
Aphididæ	1	Cerambycidæ	1
Cicadidæ	1	Chrysomelidæ	3
Membracidæ	1	Curculionidæ	1
Hemiptera			
Lygaeidæ	2		18
Miridæ	1		

The marsh elder which fringed one bank of the marsh was inhabited by plant lice and five species of coccinellids. The lampyrid *Chauliognathus marginatus* was also rather plentiful on this plant, as were numerous specimens of the lace-wing *Chrysopa oculata* Say and its long stalked eggs. During the sweeping of these plants in July and August several females of *Tibicen*

chloromera Walker were disturbed. In addition, many of the bushes were infested by nymphs and adults of the membracid *Micrutalis calva* Say and adults persisted from early June until the middle of September. The mirid *Lygus pratensis* L. was present, and several species of *Lygaeidæ*. The curculionid *Boris interstitialis* Say was observed feeding on the stems and during June and July large numbers of the chrysomelids *Paria canella aterrима* Oliv., and *Systema pallicornis* Fab., appeared and fed extensively on the leaves and stems, causing them finally to turn brown and die. In addition, some of the stems which were cut open were found to contain cerambycid larvæ.

INSECTS TAKEN IN FLIGHT OR BY SWEEPING THE MARSH

Order and family	Number of species	Order and family	Number of species
Platyptera		Erotylidæ	1
Sialidæ	1	Histeridæ	1
Odonata		Daseyllidæ	1
Agrionidæ	2	Lampyridæ	1
Libellulidæ	2	Malachidæ	2
Homoptera		Cleridæ	1
Fulgoridæ	9	Bostrychidæ	1
Cicadellidæ	9	Scarabaeidæ	1
Chermidæ	2	Chrysomelidæ	7
Hemiptera		Mordellidæ	1
Pentatomidæ	5	Curculionidæ	7
Lygaeidæ	6	Calandridæ	2
Nabidæ	1	Lepidoptera	
Reduviidæ	1	Pyralidæ	2
Anthocoridæ	1	Microlepidoptera	2
Miridæ	2	Hymenoptera	
Salidæ	1	Braconidæ	2
Orthoptera		Ichneumonidæ	8
Acridiidæ	3	Eulophidæ	1
Locustidæ	2	Pteromalidæ	2
Coleoptera		Encyrtidæ	1
Cincindelidæ	1	Diapriidæ	1
Carabidæ	5	Ceraphronidæ	1
Staphylinidæ	2	Formicidæ	5
Phalacridæ	2	Tiphidæ	1
Coccinellidæ	1	Eumenidæ	1

Order and family	Number of species	Order and family	Number of species
Ceropalidæ	1	Pipunculidæ	3
Sphecidæ	2	Syrphidæ	4
Crabronidæ	1	Tachinidæ	5
Larridæ	1	Sarcophagidæ	2
Halictidæ	2	Muscidæ	3
Dryinidæ	1	Anthomyidæ	5
Diptera		Scatophagidæ	1
Tipulidæ	3	Borboridæ	2
Chironomidæ	3	Sciomyzidæ	2
Culicidæ	2	Ortalidæ	2
Mycetophilidæ	1	Ephydridæ	7
Stratiomyidæ	2	Oscinidæ	7
Tabanidæ	7	Agromyzidæ	2
Dolichopodidæ	9		

Most of the above species were taken by sweeping the marsh vegetation, the exceptions mainly being the *Carabidæ*, most of which were taken on the ground and the pentatomids *Podops cinctipes* Say found among the flat, matted stems of *Juncus gerardi* and *Rhytidolomia saucia* Say in similar situations on *Spartina patens*. Four species of dragon flies were captured and of these, *Erythrodiplax berenice* D., appeared to be quite common. Of all the families listed, the *Cicadellidæ* was one of the best represented, some ten species having been captured, several of which were quite common. *Spartina patens*, *Distichilis spicata* and *Spartina glabra* seemed to be very attractive to fulgorids and cicadellids, some species occurring in countless numbers and whitening the foliage by their feeding. *Draculacephala mollipes* Say, *Hecalus lineatus* (Uhl.) and a species of *Thamnotettix* were rather plentiful. In the *Fulgoridæ*, *Aphelonema decorata* (Van D.), *Pissonotus aphidioides* Van D., *Oliarus humilis* (Say) were quite conspicuous.

In the Hemiptera, *Nabis ferus* L., *Trigonotylus ruficornis* Geoff., and *T. uhleri* Reut., were present in numbers. In the Coleoptera only a single specimen of the salt marsh tiger beetle, *Cicindela marginata* Fab., was taken. The staphylinid *Trogophlæus nanulus* Csy., was frequently captured and the only other species noted in numbers aside from those mentioned as feeding

on marsh elder, was *Hypera punctata* Fab., the clover leaf beetle. This curculionid was quite plentiful during the last of August and first part of September resting on erect stems of *Spartina patens* and on the upper portions of *Spartina glabra*. Mention should be made of the presence of *Sphenophorus setiger* Chit., and *S. venatus* Say which probably breed in reeds and grasses. In the Hymenoptera, the most plentiful species were *Chelonus sassacus* Vier. (*Braconidæ*), *Bassus* sp., *Hemiteles areator tenellus* Say (*Ichneumonidæ*), a species of *Eulophidæ* and a species of *Chloralictus*.

The best represented order was the Diptera with thirty-four per cent of the total number of species collected. Species present in large numbers were *Helobia hybrida* Meig., (*Tipulidæ*), *Aedes sollicitans* Wlk., (*Culicidæ*), *Nemotelus melanderi* Bks., (*Stratiomyidæ*), *Tabanus nigrovittatus* Macq., (*Tabanidæ*), *Sympycnus lineatus* Lw., *Dolichopus marginatus* Aldr., *Pelastoneurus lamellatus* Lw., (*Dolichopodidæ*), *Pipunculus scoparius* Cress., (*Pipunculidæ*), *Platychirus quadratus* Say, *Toxomerus marginatus* Say (*Syrphidæ*), *Myiophasia atra* D., (*Tachinidæ*), *Limnospila albifrons* Zett., *Lispa albitarsis* Stein., *Cænoscia lata* Wlk., (*Anthomyidæ*), *Leptocera limosa* Meig., (*Borboridæ*), *Chaetopsis œnea* Wd., *C. apicalis* Johns., (*Ortolidæ*), *Botanobia dorsata* Aldr., and *B. trigramma* Lw. The last mentioned species was present by millions and sometimes filled our nets almost to the exclusion of other species.

SUMMARY

The foregoing tables and text show that the salt marsh supports a varied insect fauna. Prof. John B. Smith (Insects of New Jersey, N. J. St. Mus. Rept. 1909, p. 30) writing about the coastal strip of New Jersey including the marshlands lying between the bars fringing the coast and the mainland speaks of the insect fauna as being scant. Used relatively as was probably intended, this is true, but the salt marsh of New Jersey is far from being devoid of species. The next two tables deal with the species present by orders and with the types of food habits, the latter being based for the most part on the predominating larval habits of the

families and on the species present, regardless of numerical abundance. The disadvantage of using the family as a unit is appreciated and this matter and that of numerical abundance have been gone into in a former paper.

INSECTS OF THE MARSH.

Order	Number of species	Per cent of total
Platyptera	1	
Neuroptera	1	
Odonata	4	2
Homoptera	24	11
Hemiptera	20	10
Orthoptera	5	3
Coleoptera	48	23
Lepidoptera	4	2
Hymenoptera	31	15
Diptera	72	34
	<hr/>	<hr/>
Totals	210	100

TYPES OF FOOD HABITS.

	Number of species	Per cent of total
Phytophagous	82	39
Saprophagous	44	21
Harpactophagous	55	26
Parasitic	26	13
Pollen feeders	2	1

As shown above, in point of number of species, the Diptera are the most important, followed in turn by the Coleoptera, Hymenoptera, Homoptera and Hemiptera. As shown by the last table, in a general way and regardless of numerical abundance, 39 per cent of the species present can be classed as phytophagous, 21 per cent as saprophagous, 26 per cent. as harpactophagous and 13 per cent as parasitic. The phytophagous percentage is made up largely by the *Fulgoridæ*, *Cicadellidæ*, *Lygæidæ* and several species of Coleoptera, Orthoptera and Lepidoptera. The saprophagous percentage consists for the most part of members of the

Diptera and their presence on a marsh containing a large amount of organic matter is not unusual. Predaceous species were supplied mostly by the Diptera and Coleoptera followed by the Hemiptera, Hymenoptera and Odonata. The Hymenoptera and Diptera supplied all of the parasitic species. It is believed that a fair sample of the species present on the marsh was obtained and that the types of food habits indicated above, as being associated with the marsh vegetation described, will be found in approximately the same ratios in other similar marsh areas.

EXPLANATION OF FIGURES

- Fig. 1, A view of a stream (at low tide) on one side of the surveyed area showing the growth of *Spartina glabra* along the edges.
- Fig. 2, A general view showing the wide stream on another side of the surveyed area.
- Fig. 3, A view of the surveyed area showing *Spartina glabra* in the foreground. *Spartina patens* occupies a large proportion of the balance of the area.

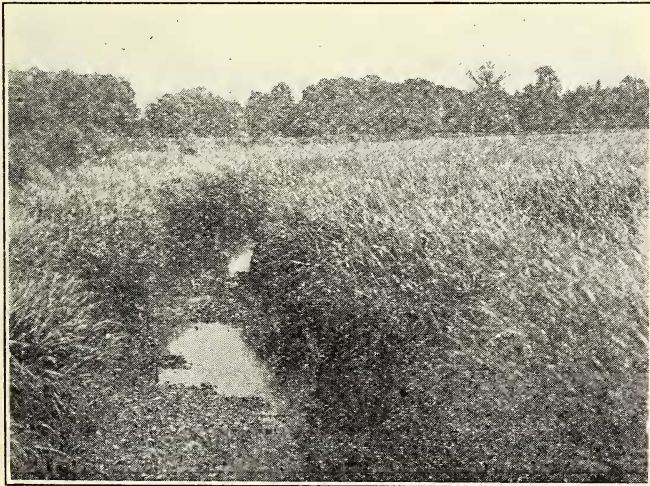


Figure 1

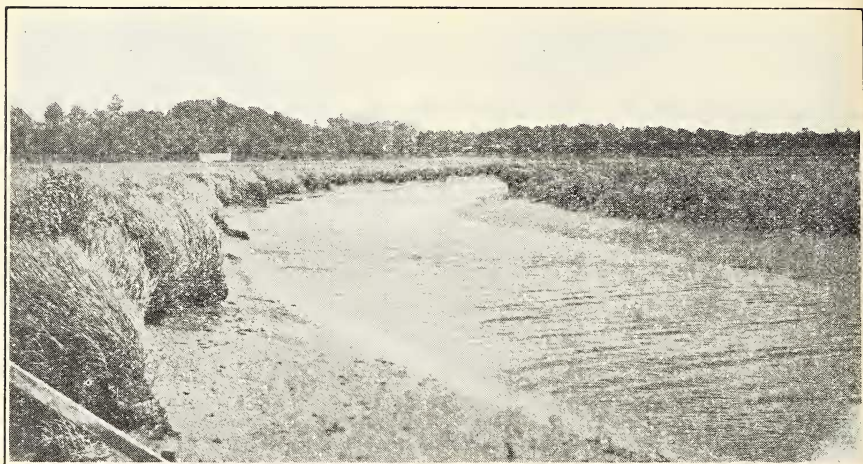


Figure 2

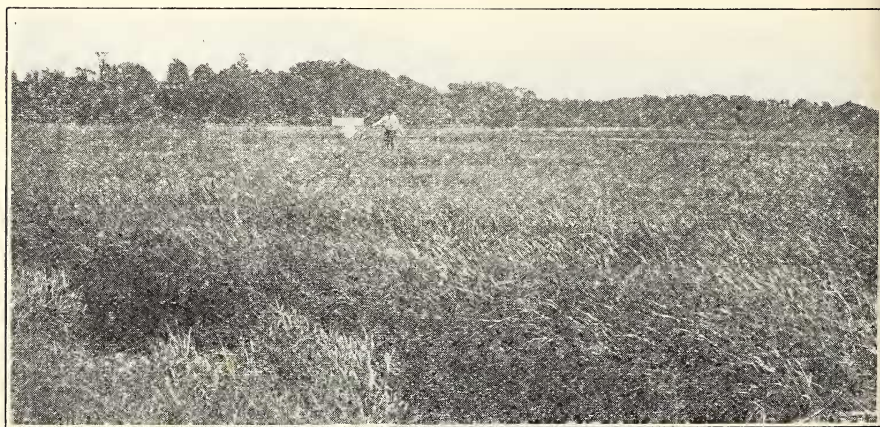


Figure 3